HICKOK

Model 239
COLOR BAR GENERATOR
INSTRUCTION MANUAL

HICKOK THE HICKOK ELECTRICAL INSTRUMENT COMPANY
10514 Dupont Avenue • Cleveland, Ohio 44108

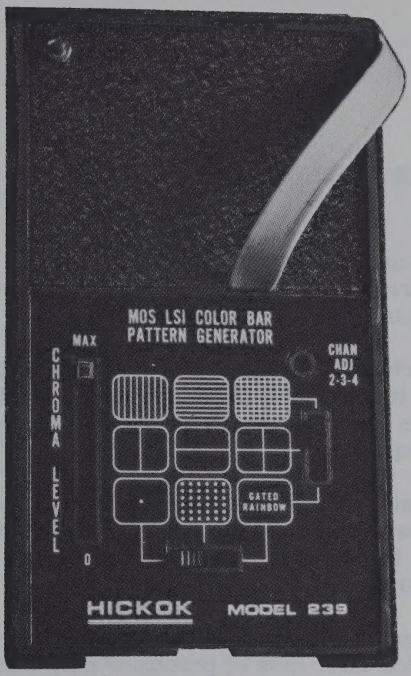

Figure 1

Model 239
COLOR BAR GENERATOR
INSTRUCTION MANUAL

PUBLICATION NO. 2490-644

The Hickok Electrical Instrument Company

10514 DUPONT AVENUE • CLEVELAND, OHIO 44108 • (216) 541-8060 • TWX: 810-421-8286

HICKOK

WARRANTY

IMPORTANT

The following warranty shall be void if the registration card is not properly completed and returned to the Hickok factory, post marked within ten days after date of purchase.

The Hickok Electrical Instrument Co. warrants this instrument of its manufacture to be free from defects in material and workmanship for a period of two years (24 months) from the date of original purchase, subject to the following conditions.

a. Any instrument found to be defective during the first twelve month period after date of purchase may be returned, transportation prepaid, to the factory for repair or, at our option, replacement without charge.

b. Any instrument found to be defective during the second twelve month period after date of purchase may be returned, transportation prepaid, to the factory for repair subject to a minimal handling charge for each time the instrument is returned. Contact the Hickok factory for information regarding this service charge.

This warranty does not apply to any of our products which have been repaired or altered by unauthorized persons, or which have been subject to misuse, negligence, or accident, or which have had the serial number altered, effaced or removed. Neither shall the warranty apply where a warranty registration card has not been properly completed and returned to us promptly after purchase. This warranty is in lieu of all other warranties whether expressed or implied.

RETURNING EQUIPMENT FOR REPAIR

Before returning any equipment for service, the factory must first be contacted, giving the nature of the trouble. Instructions will then be given for either correcting the trouble or returning the equipment. Upon authorization, this equipment should be forwarded directly either to the Hickok factory address at 10514 Dupont Avenue, Cleveland, Ohio, 44108, or to a designated service station in your locality.

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HOW TO USE THIS MANUAL

This manual is divided into two sections. Section 1 contains descriptive data, condensed instructions, and specifications. Section 2 contains complete operating instructions. The first section provides sufficient information for a quick check of a color TV receiver. The second section includes more detailed instructions to aid in solving service problems.

SECTION 1

DESCRIPTION AND SPECIFICATIONS

WHAT YOUR MODEL 239 DOES

Your Model 239 instantly provides all signals required for testing alignment and convergence of all types of TV receivers. It is entirely solid state. The following display patterns and functions are provided:

TEN STANDARD COLOR BARS: Crystal controlled keyed bars with 30 degrees phase change between each, offer complete coverage of colors for every color circuit test.

HORIZONTAL BARS: For fast adjustment of vertical convergence.

VERTICAL BARS: For fast adjustment of horizontal convergence.

DOTS: Static convergence and precise final convergence adjustments.

CROSSHATCH: For convergence adjustments as well as for fast overall linearity and size adjustments.

RF FREQUENCY RANGE: Tunable to channels 2, 3, and 4. Shipped from the factory adjusted to channel 2. If desired, Model 239 can be quickly adjusted to channel 3 or 4 through the front panel. If channel 2 is in local use, adjustment to channel 3 or 4 is a quick one-time operation.

SOME UNUSUAL FEATURES OF THE MODEL 239

The Hickok Model 239 Color Bar Generator is the forerunner of things to come in the field of test equipment for the serviceman. Employing the most modern design technology available, it provides maximum performance and reliability even under the most adverse service conditions.

The circuitry of the Model 239 is built around a custom made MOS Integrated Circuit designed by Hickok specifically for use in this equipment. The MOS IC includes the equivalent of 1000 transistors. This technique results in a design using all digital logic to produce timing signals necessary to generate the various patterns on the TV receiver. The IC provides unequaled performance and stability combined with simplified construction and wiring resulting in a design which is both economical and highly reliable.

The design of the custom IC includes parameters which constrain the unit to exactly match the FCC requirements for color television signals.

In addition to the custom MOS IC, highly reliable integrated circuits and silicon transistors have been used and individual resistors, capacitors and switches are of the highest industrial quality.

Components, including the switches are mounted directly on the glass epoxy printed circuit board. This provides a minimum of connections thus eliminating harnesses and individual wire leads.

With the user in mind, the front panel controls have been arranged to use convenient linear adjustment controls and slide switches.

The Model 239 incorporates such features as an automatic shut off, when the cover is closed, to conserve batteries. The case beneath the latch includes a clearance slot so the twin lead RF output cable can be conveniently wrapped around the case rather than coiled in the cover.

The equipment is designed to operate from two standard 9 volt transistor batteries which will provide approximately 30 hours of operation.

Rechargeable nickel-cadmium batteries can be substituted for the standard dry batteries; in which case Hickok offers a battery charger designed for use with the Model 239.

Refer to the equipment specifications for the proper battery type numbers.

CONTROLS AND THEIR USES

DISPLAY SELECTORS

The DISPLAY SELECTOR slide switches select the type of pattern or display to be shown on the TV screen. The selected display modulates the RF oscillator. The composite snyc signal is present at all times at the modulator to keep the selected display locked on.

The following table lists the TV adjustments for which the various display patterns are used:

USE OF PATTERNS

Adjustment for:	Patterns
1. Color sync and demodulator circuits	Gated rainbow
2. Centering, or positioning	Single crossbar, or single horizontal and vertical lines
3. Height, Linearity, and Pin-cushion effect	Horizontal and vertical lines, cross-hatch
4. Static Convergence	Single crossbar, single dot, single horizontal and vertical lines
5. Dynamic convergence	Dots, crosshatches, horizontal and vertical lines

CHROMA LEVEL

The CHROMA LEVEL varies the amount of color signal that the Model 239 applies to the color TV receiver. The signal is used to test operation of the receiver's color circuits. At max setting, the control provides 150% of the necessary color signal amplitude. At 2/3 of max setting the control provides a color signal amplitude which is in proper proportion to the composite video signal from the Model 239. Settings other than 100% position of the chroma signal are useful in checking the action of color circuits with abnormally high or low color signals.

CHANNEL ADJUST 2, 3, 4

The CHANNEL ADJUST is a continuously variable control which controls the RF output of the Model 239 for use with channels 2, 3, or 4. The unit is factory adjusted for channel 2. If it is desired to change to channel 3 or 4, see Operating Instructions Section 2 of this manual.

POWER ON-OFF SWITCH

An automatic interlock switch turns the Model 239 Color Bar Generator on and off as the cover of the equipment is opened or closed to prevent accidental discharge of the batteries.

REPLACING BATTERIES

To replace the batteries in your Model 239 remove the four screws on the rear of the unit. Remove the old batteries and snap in the new. If you are using rechargeable batteries the same procedure applies. The connector for use with the Hickok 20800-421 charger is located on the side of the case.

HOW TO CONNECT THE MODEL 239 TO A TV RECEIVER

To connect the Model 239 Color Generator to a TV receiver proceed as follows:

a. Disconnect the external antenna of the TV receiver. It remains off during test procedures and adjustments.

b. Connect the 300Ω twin lead cable to the antenna terminals of the TV receiver.

c. Turn the TV receiver on. Allow a period of warm-up.

MODEL 239 COLOR BAR GENERATOR

SPECIFICATIONS AND REFERENCE DATA

CRYSTAL CONTROL FREQUENCIES:

Master timer control:	378kHz ±.005%
Chroma carrier:	3,563,795 Hz ±.001%

DISPLAY PATTERNS PROVIDED:

(All signals in accordance with FCC chroma signal specifications)

Color Bars:	Gated Rainbow Level adjustable from 0 to 150% of sync signal
Dots:	Fine: 15 x 21 Single: At center of raster
Crosshatch:	Fine: 15 x 21 Single: Crossbar intersecting at center of raster
Vertical Lines:	Fine: 21 lines Single: At center
Horizontal Lines:	Fine: 15 lines Single: At center

RF CARRIER: Tunable to channels 2, 3, or 4 by screwdriver adjustment on front panel. Modulated by selected display pattern. Connection to TV receiver by 300Ω twin lead.

BATTERY REQUIREMENTS:

Non-rechargeable: (30 hrs approx. operating life)	2 standard 9 volt transistor radio batteries. Eveready No. 216, Mallory No. MN1604, or Burgess No. 2U6.
Rechargeable (Ni-Cad): (4 hrs approx. operating time between charges)	2 Eveready No. N88 or equivalent.

BATTERY CHARGER: (Not supplied with equipment)	Hickok Part No. 20800-421 plugs into jack provided on Model 239 case. Use only with rechargeable batteries specified above.

NOTE

THE MODEL 239 MAY BE OPERATED WHILE PLUGGED INTO THE POWER LINE; HOWEVER, THE CHARGER WILL NOT SUPPLY SUFFICIENT CURRENT TO CHARGE THE BATTERIES WHILE THE UNIT IS OPERATING. THEREFORE, THE UNIT MUST BE TURNED OFF (COVER CLOSED) FOR RECHARGING.

SIZE:	5-3/4 x 3-3/8 x 1-7/8 inches.
WEIGHT:	12.5 oz

SECTION 2

GENERAL INFORMATION AND OPERATING INSTRUCTIONS

INTRODUCTION

The Hickok Model 239 Color Generator provides the service technician with the means of satisfactorily servicing color TV receivers. It provides a standard gated rainbow color bar signal, as well as horizontal line, vertical line, crosshatch, and dot pattern displays. These capabilities are necessary for proper alignment of a color TV receiver.

COLOR TV

Color TV is not difficult to understand if comparison with black and white TV is considered. In black and white TV the material on the inside of the cathode ray tube is made to fluoresce by passing electronic beams successively and repeatedly over the inside face of the tube. By controlling the location and intensity of the beam we create the illusion of form and motion which is called the "image". This is accomplished by means of an electron gun in the cathode ray tube.

In color TV the situation is a little bit different in that there are three primary colors, "red", "blue", and "green", to consider. This means three guns in the TV tube. It also means three different materials on the face of the tube (the fluorescent screen). Each separate fluorescent material will fluoresce only when excited by its own electronic beam. Obviously the location of the fluorescent material now becomes critical. In black and white TV the fluorescent material is uniform over the entire area of the inside face of the tube. In color TV the red, blue, and green materials are placed in a pattern of very small dots with their centers forming equilateral triangles with each apex having one small dot. These are called "trios". Any one of the dots of the trio reacts only when hit by its own electronic beam. Therefore, the proper alignment of the electronic beams from each color gun is imperative.

OPERATING INSTRUCTIONS

GENERAL

Due to the magnetic sensitivity of color receivers, it is desirable to make color and alignment adjustments at the site of the permanent location of the receiver. However, this is not always possible. The light weight and portability of the Model 239 lends itself particularly to home use although it may also be used in the shop. It is usually desirable to give the TV receiver a final touch-up at its permanent location, if it has been serviced elsewhere.

CHANGING MODEL 239 TO CHANNEL 3 OR 4

The Model 239 is factory adjusted to channel 2. If channel 2 is an active TV channel in any given area, it is preferable to adjust the generator to either channel 3 or 4, whichever is not active. This is a front panel adjustment using the CHANNEL ADJUST 2, 3, 4, control. This control is the RF oscillator capacitor (C115 on the schematic diagram). To make a channel change of the generator, proceed as follows:

a. Turn on a properly operating TV receiver. Allow it to warm-up.

b. Tune to channel 2 and adjust the fine tuning for a satisfactory image, either black and white or color. Without changing any of the other controls, turn the station selector of the TV receiver to the unused channel 3 or 4, and adjust the TV receiver fine tuning to the approximate center of its range.

c. Disconnect the external antenna from the TV receiver.

d. Connect the twin lead 300Ω cable of the generator to the antenna terminals of the TV receiver.

e. Set DISPLAY SELECTOR slide switches for crosshatch display.

f. Using a plastic screwdriver turn the CHANNEL ADJUST 2, 3, 4 adjustment until the best possible crosshatch display appears on the TV receiver screen. Make a final tuning adjustment by tuning the generator until the vertical and horizontal lines of the crosshatch pattern appears to be equal in brightness. This can best be determined with the TV brightness control set to a low level.

PRELIMINARY

The service-technician who establishes a routine sequence in his testing saves himself a great deal of work and time. He is less apt to follow false leads. Frequently a slight touch-up is all that is required. The following sequence of procedure is recommended.

DEGAUSSING

To remove unwanted stray magnetism from the color TV receiver, degauss it at the beginning of all testing or adjusting. To do this, place a degaussing coil on the floor about ten feet in front of the receiver. Energize it. Lift the coil to the level of the TV receiver and hold it in a plane parallel to the face of the TV tube. Move coil to within a couple of inches of the face of the tube, maintaining the parallel plane between coil and tube. In a circular motion, pass the coil over the face of the tube a half-dozen times. In a similar manner move the coil around the sides, top, and (if possible) the bottom of the receiver, always maintaining the plane of the coil parallel to the top, sides, and bottom. Return the coil to the face of the TV receiver, and for good measure, pass the coil over the face of the tube a few times.

Maintaining the parallel plane, move the coil away from the face of tube a distance of about ten feet. Turn the coil 90 degrees to the face of the tube and de-energize the coil.

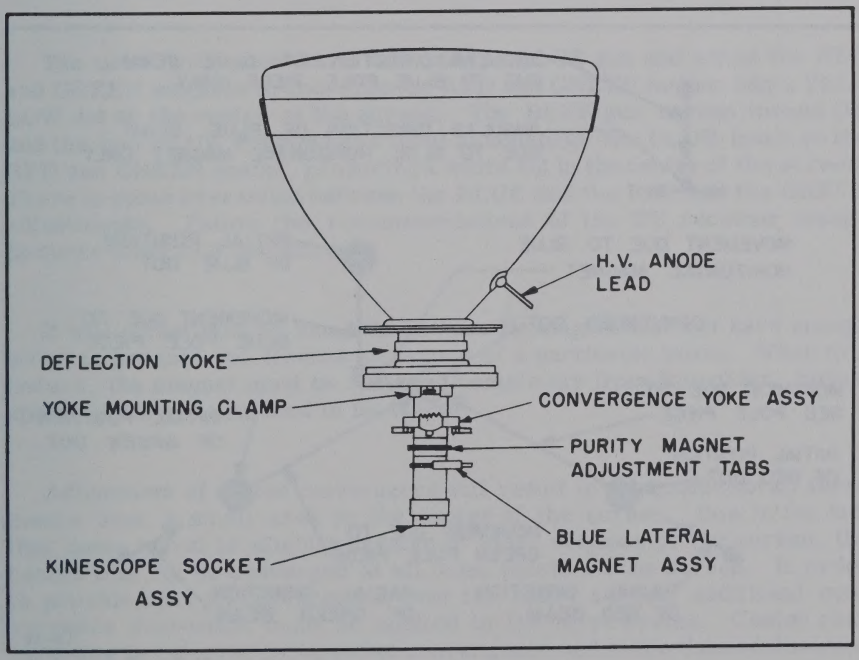


Figure 2. Typical Components Located on Picture Tube Neck

COLOR PURITY - GENERAL

The purpose of purity adjustment is to compensate for misalignment that may exist between the position of the three electronic gun beams and the center of deflection of the tri-color picture tube.

The direction of displacement of the beams is controlled by rotation of the purity magnet, while the amount of displacement is controlled by the strength of the magnetic field. It might be convenient to think of purity adjustment as repositioning of the entire three gun structure with respect to the neck, screen mask, and the phosphor screen in the color picture tube. Proper positioning will permit each of the beams to strike its respective phosphor dots.

Purity adjustments are made with only one gun in operation, while the other two guns are biased to cut-off. In this way we can determine if the correct beam is striking the proper phosphor dots to produce a pure color field. When adjusting use the red beam. Impurities are more readily observed on the red screen than either the blue or green screens. A portion of the red beam, falling on blue or green phosphor dots will illuminate them and contaminate the red field. If this condition occurs, color impurity results. A pure red raster is obtained by adjustment of the static convergence magnets on the convergence yoke assembly, the purity magnet adjustment tabs, and the deflection yoke. See figure 2. Before beginning purity or convergence adjustments, make sure that all picture centering, size, linearity, and focus adjustments are properly set.

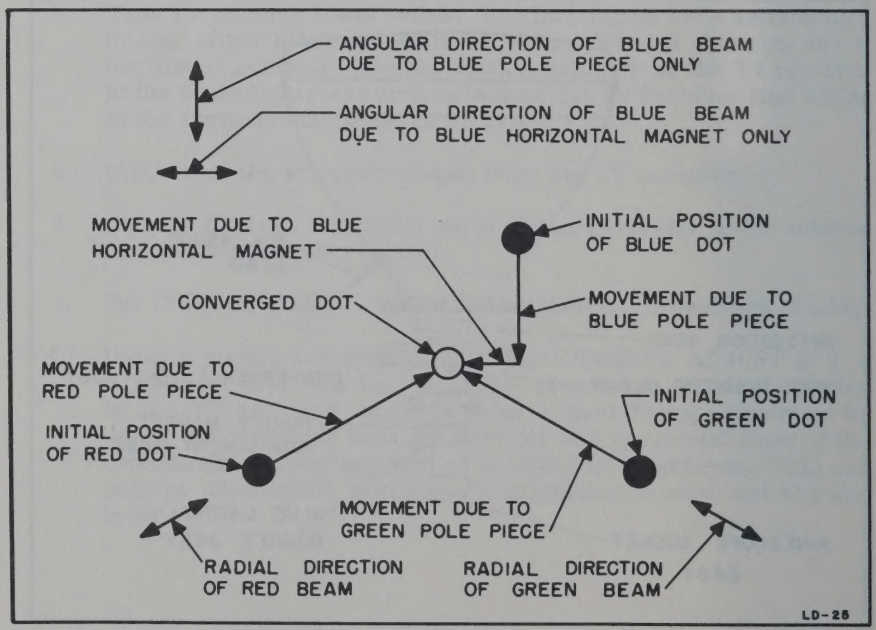

ANGULAR DIRECTION OF BLUE BEAM DUE TO BLUE POLE PIECE ONLY
ANGULAR DIRECTION OF BLUE BEAM DUE TO BLUE HORIZONTAL MAGNET ONLY
MOVEMENT DUE TO BLUE HORIZONTAL MAGNET
INITIAL POSITION OF BLUE DOT
CONVERGED DOT
MOVEMENT DUE TO BLUE POLE PIECE
MOVEMENT DUE TO RED POLE PIECE
INITIAL POSITION OF GREEN DOT
INITIAL POSITION OF RED DOT
MOVEMENT DUE TO GREEN POLE PIECE
RADIAL DIRECTION OF RED BEAM
RADIAL DIRECTION OF GREEN BEAM
LD-25

Figure 3. Direction of Movement of Red, Green, and Blue Beams

BLACK AND WHITE TRACKING (GRAY SCALE ADJUSTMENT).

Due to the different design characteristics of TV receivers, Black and White Tracking adjustments should be made in accordance with the TV receiver manufacturer's instructions.

CONVERGENCE - GENERAL

For correct black-and-white reproduction, it is necessary that the three beams meet or converge on the screen mask, proceed through their respective holes in the screen mask, and then reflect upon and excite their respective color dots. During manufacture of the tube, the three color guns are mechanically tilted toward the central axis of the tube so that virtual center convergence is obtained without applying external convergence force. However, due to the complexities of tube manufacture, slight bending of one or more of the beams is usually required for exact center convergence. The three permanent magnets of the convergence yoke assembly and the blue-positioning magnet provide magnetic fields which facilitate this extra bending, if required, for exact center convergence. (Some older receivers use electromagnets controlled by rheostats for center convergence.)

The RED and GREEN magnets move the RED and GREEN beams diagonally, respectively. The BLUE pole piece vertical magnet moves the BLUE beam vertically and the BLUE horizontal magnet moves the BLUE beam horizontally. See figure 3.

The usual procedure is to turn off the BLUE gun and adjust the RED and GREEN magnets to converge the RED and GREEN beams into a YELLOW dot at the center of the screen. The BLUE gun is then turned ON and the two BLUE magnets are used to converge the BLUE beam on the RED and GREEN beams, producing a white dot in the center of the screen. There is some interaction between the BLUE and the RED and the GREEN adjustments. Follow the recommendations of the TV receiver manufacturer's service manual.

It will sometimes be found that a specific magnet does not have enough effect to produce the desired movement of a particular beam. When this occurs, the magnet must be removed completely from its holder, turned upside-down and replaced in its holder.

Adjustment of center convergence will result in coincidence of all three beams over a small area in the center of the screen. Due to the fact that beam travel is slightly greater to other sections of the screen, the beams will not be converged at all other points on the screen. In order to provide correct convergence over the entire screen, additional convergence correction must be applied to the three beams. Center convergence is referred to as static convergence and other than center convergence is called dynamic convergence.

The reasoning behind the color bar display is easily understood. An oscillator that is operating at a frequency of 3,563,795 cycles (the color carrier frequency of 3,579,545 cycles less the horizontal line frequency of 15,750 cycles) will appear as a 3.58 megacycle signal that is constantly changing in phase, when compared to the 3.58 megacycle reference oscillator signal in the TV receiver, such that there is a complete change in phase of 360 degrees for each horizontal line of sweep. Thus, a complete range of colors is produced during each horizontal line. Each line displays all colors the same since the phase difference between both oscillators at the beginning of the sweep is always zero. (If the phase changes 360 degrees during one sweep starting with zero phase difference at the beginning of the sweep, then it will also be zero at the beginning of the next sweep, etc.).

By gating the 3.56 megacycle oscillator at a frequency 12 times higher than the horizontal sweep frequency, color bars can be produced that are exactly 30 degrees apart all around the color spectrum as in figure 4.

Note that of the twelve gated bursts only ten show on the receiver screen as color bars. This is because one of the bursts occurs at the same time as the horizontal sync pulse and thus is eliminated. The other occurs immediately after the horizontal sync pulse and becomes the color sync burst, which is used to control the 3.58 megacycle reference oscillator in the TV receiver.

> NOTE
>
> If less than ten bars are displayed as shown in figure 4, the raster width is too great, and must be reduced by adjusting the TV receiver width control.

STATIC CONVERGENCE

With the Model 239 connected to the TV receiver as explained in Section 1 of this manual, under "How to Connect the 239 to a TV Receiver", proceed as follows for static convergence adjustments:

a. Turn the DISPLAY SELECTOR to the single dot pattern.

b. Turn the TV receiver contrast control to a minimum and adjust the brightness control so that the dot is just barely visible on the TV screen.

c. Place a jumper lead with a 100,000 ohm resistor in series from the blue color grid to the chassis of the set thus cutting out the BLUE gun. Adjust the RED and GREEN magnets to converge the RED and GREEN beams into a yellow dot.

d. Remove the jumper, thus adding the output of the BLUE gun to that of the RED and GREEN guns.

e. Adjust the BLUE horizontal magnet and the BLUE pole piece to converge the BLUE beam on the RED and GREEN beams, producing a WHITE dot.

Some touch-up of the magnets may be necessary as there is some interaction between the BLUE, RED, and GREEN adjustments.

> NOTE
>
> At this point it is advisable to recheck the purity adjustment. If purity is readjusted, the static convergence must be readjusted.

DYNAMIC CONVERGENCE

Dynamic convergence adjustment controls for the TV receiver are located on the convergence panel. Refer to the receiver manufacturer's instruction manual for the location of the convergence panel.

The service-technician's preference will determine the display to be used. The CROSS-HATCH displays are most commonly used, but HORIZONTAL BARS or VERTICAL BARS may be used with equal accuracy.

Following the instructions given in Section 1 of this manual, connect the Model 239 to the TV receiver.

Dynamic convergence procedures vary with each color TV receiver. To make these adjustments to the manufacturer's specifications, his service literature must be followed. Following satisfactory convergence adjustments, it is desirable to re-check the black and white tracking (the gray scale adjustment).

COLOR CHECK

Connect the Model 239 to the TV receiver as explained in Section 1. To make a color check, proceed as follows:

Set the CHROMA LEVEL control at approximately 2/3 of its maximum setting. If the TV receiver has been properly adjusted, the color bar display should appear on the TV screen as in figure 4.

If the colors do not appear, improper adjustment of the color killer circuit in the TV receiver may be the trouble. This circuit is designed to cut off the color circuit when no color signals are present. Without this cut-off feature the black and white signals would produce a "confetti" appearance. If the "threshold" of this circuit is set too high, the color signals are blocked. To test this, set the CHROMA LEVEL control at max. Adjust the killer threshold until the colors do appear. Consult the TV receiver manufacturer's service literature for this adjustment.

After the killer threshold has been adjusted, turn the CHROMA LEVEL control toward zero. The color should disappear from the TV receiver screen before the CHROMA LEVEL control reaches zero. In the event that the colors do not disappear, this indicates that the threshold of the killer circuit in the TV receiver is set too low.

MAINTENANCE AND CALIBRATION

Your Model 239 Color Bar Generator has been constructed using the latest components and techniques that the electronic technology has to offer. It has been designed for long reliable service as indicated by your two (2) year warranty.

Should difficulty be encountered with your Color Bar Generator, the Hickok Electrical Instrument Co. maintains a complete service facility for reliable and timely service of our products.

A troubleshooting procedure is not presented in this manual. The experienced electronic technician can easily interpret the Schematic and Parts Location diagrams for routine troubleshooting; however, it should be noted that the semiconductor devices used in this equipment are of such sophistication that they are not in general distribution. In addition, the necessary test equipment for adjustment and repair of this instrument is not generally available.

The following adjustments should be checked before returning the Model 239 for service.

a. Be sure the CHANNEL ADJUST 2, 3, 4 control is adjusted to a suitable clear TV channel for your area. Refer to OPERATING INSTRUCTIONS given earlier in this section. This adjustment can be made through the front panel using a plastic screwdriver.

b. If a frequency counter, having accuracy of 1 part in 1 million ($1/10^6$), proceed as follows:

    1. Remove the battery cover which is secured by 4 screws on the back of the case and the remaining screw which secures the printed circuit board in place.

    2. Carefully remove the board assembly from the case and connect the frequency counter between the emitter of transistor Q104 and ground.

    3. Adjust C111 for a reading of 3,563,759 Hz on the frequency counter.

    4. Replace the printed circuit board and battery cover.

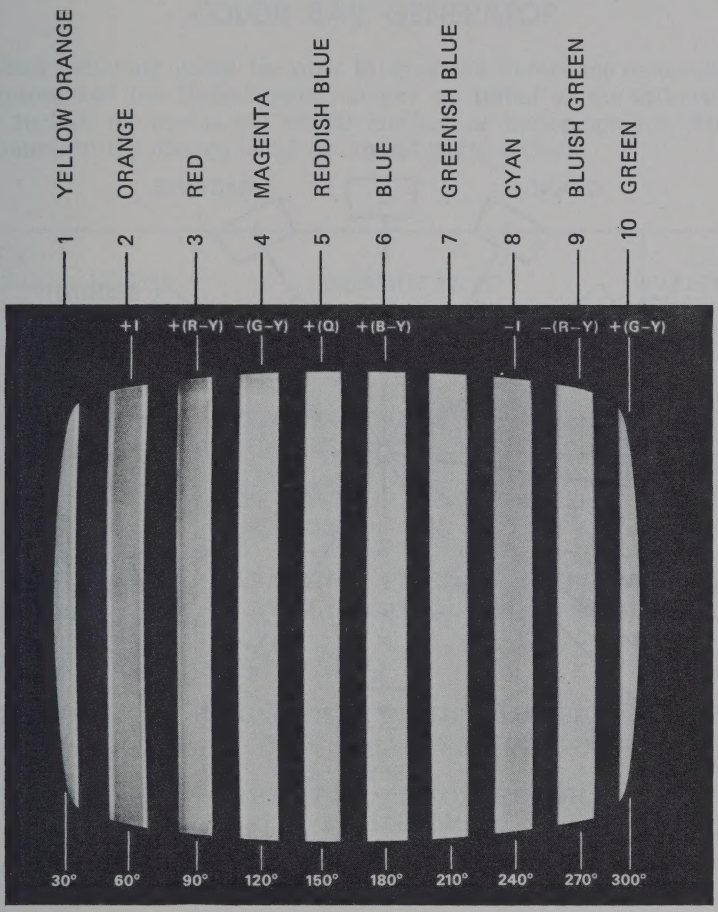


Figure 4. Gated Rainbow Pattern

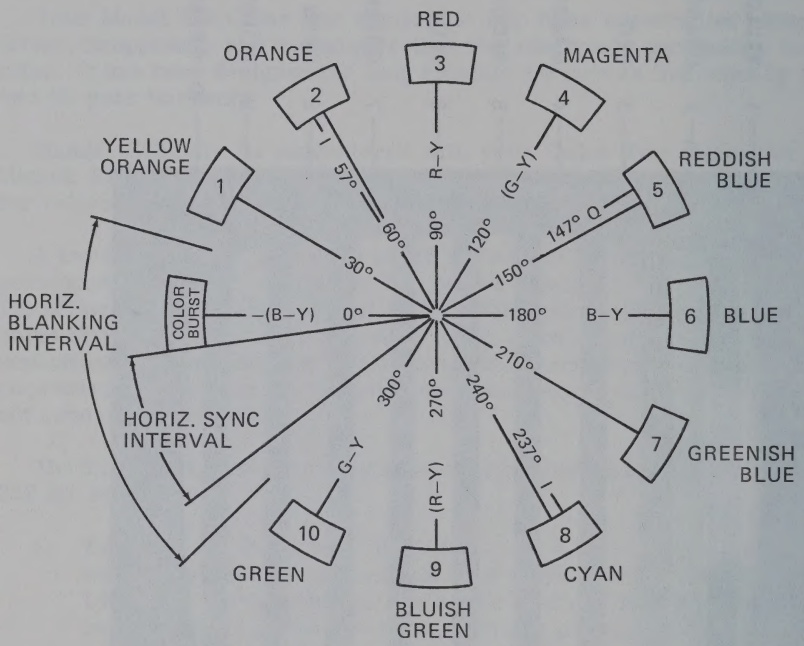


Figure 5. Phase Relations in the Gated Rainbow Signal

PARTS LIST
MODEL 239
COLOR BAR GENERATOR

When ordering parts be sure to give the reference designation, description, and the Hickok part number as listed in the following table. Also include the model and serial number of the equipment. There is a minimum billing charge of $5.00 for all parts orders.

REF DESIG.	NOTES	DESCRIPTION	HICKOK PART NO.
AR101		INTEGRATED CIRCUIT: PITA4 with GPSR chip MM5322	9800-120
AR102		INTEGRATED CIRCUIT: linear, CA3086	9800-121
AR103		INTEGRATED CIRCUIT: linear, CA3053	9800-125
C101		CAPACITOR, FIXED, ELECTROLYTIC: tantalum, 1 uf, 35 volts	3085-433
C102		Same as C101	
C103		CAPACITOR, FIXED, ELECTROLYTIC: tantalum, 22 uf, 15 volts	3085-491
C104		CAPACITOR, FIXED, CERAMIC: 47 pf, 2%, 100 volts	3110-337
C105		Same as C104	
C106		CAPACITOR, FIXED, COMPOSITION: 6.8 pf, 10%, 500 volts	3116-21
C107		CAPACITOR, FIXED, ELECTROLYTIC: tantalum, 2.2 uf, 35 volts	3085-490
C108		Same as C104	
C109		CAPACITOR, FIXED, CERAMIC: 22 pf, 2%, 100 volts	3110-338

REF DESIG.	NOTES	DESCRIPTION	HICKOK PART NO.
C110		Not used	
C111		CAPACITOR, VARIABLE: 0-10 pf, trimmer	3115-91
C112		CAPACITOR, FIXED, CERAMIC: 220 pf, 2%, 100 volts	3110-336
C113		Same as C106	
C114		Same as C106	
C115		Same as C111	
C116		Same as C109	
C117		CAPACITOR, FIXED, CERAMIC: 330 pf, 2%, 100 volts	3110-335
C118		Same as C112	
C119		Same as C112	
CR101		SEMICONDUCTOR DEVICE: diode 1N5736B, 10 volt zener, 5%	3870-319
CR102		SEMICONDUCTOR DEVICE: diode 1N914	3870-175
J101		JACK: phone, 2 conductor open circuit	10300-41
L101		COIL: 2.2 Mh	3320-373
L102		COIL: 1 Mh	3320-372
L103		COIL: 56 uh	3320-376
L104		COIL: .47 uh	3320-375
Q101		TRANSISTOR: BC308B, silicon, PNP	20861-357
Q102		Same as Q101	
Q103		TRANSISTOR: A139, silicon, NPN	20861-316

REF DESIG.	NOTES	DESCRIPTION	HICKOK PART NO.
Q104		Same as Q103	
Q105		Same as Q103	
R101		RESISTOR, FIXED, DEPOSITED CARBON: 100K ohms, 5%, 1/4 watt	18470-104
R102		RESISTOR, FIXED, DEPOSITED CARBON: 24K ohms, 5%, 1/4 watt	18470-243
R103		Same as R101	
R104		RESISTOR, FIXED, DEPOSITED CARBON: 33K ohms, 5%, 1/4 watt	18470-333
R105		RESISTOR, FIXED, DEPOSITED CARBON: 75K ohms, 5%, 1/4 watt	18470-753
R106		RESISTOR, VARIABLE: miniature, 22K ohms, 20%, .1 watt	16925-812
R107		RESISTOR, FIXED, DEPOSITED CARBON: 22K ohms, 5%, 1/4 watt	18470-223
R108		Same as R107	
R109		RESISTOR, FIXED, DEPOSITED CARBON: 2K ohms, 5%, 1/4 watt	18470-202
R110		RESISTOR, FIXED, COMPOSITION: 18 megohms, 10%, 1/2 watt	18416-182
R111		RESISTOR, FIXED, DEPOSITED CARBON: 82K ohms, 5%, 1/4 watt	18470-823
R112		Same as R107	
R113		RESISTOR, FIXED, DEPOSITED CARBON: 5.1K ohms, 5%, 1/4 watt	18470-512

REF DESIG.	NOTES	DESCRIPTION	HICKOK PART NO.
R114		Same as R113	
R115		RESISTOR, FIXED, DEPOSITED CARBON: 150 ohms, 5%, 1/4 watt	18470-151
R116		Same as R104	
R117		RESISTOR, FIXED, DEPOSITED CARBON: 51K ohms, 5%, 1/4 watt	18470-513
R118		RESISTOR, FIXED, DEPOSITED CARBON: 47K ohms, 5%, 1/4 watt	18470-473
R119		RESISTOR, FIXED, DEPOSITED CARBON: 7.5K ohms, 5%, 1/4 watt	18470-752
R120		RESISTOR, VARIABLE: 10K ohms, 30%, 1 watt, slide type	16925-813
R121		RESISTOR, FIXED, DEPOSITED CARBON: 43K ohms, 5%, 1/4 watt	18470-433
R122		Same as R101	
R123		Same as R119	
R124		RESISTOR, FIXED, DEPOSITED CARBON: 6.8K ohms, 5%, 1/4 watt	18470-682
R125		Same as R104	
R126		RESISTOR, FIXED, DEPOSITED CARBON: 10K ohms, 5%, 1/4 watt	18470-103
R127		RESISTOR, FIXED, DEPOSITED CARBON: 300 ohms, 5%, 1/4 watt	18470-301
R128		RESISTOR, FIXED, DEPOSITED CARBON: 100 ohms, 5%, 1/4 watt	18470-101

REF DESIG.	NOTES	DESCRIPTION	HICKOK PART NO.
R129		Same as R128	
R130		Same as R128	
S101		SWITCH: pushbutton, miniature, momentary	19910-241
S102		SWITCH: slide, sub-miniature, 3p 3t	19911-142
S103		Same as S102	
Y101		CRYSTAL: 377.4 kHz, tolerance ±.01% at 0-85°C, parallel resonant 32 pf load, max. resonant resistance of 3K ohms	3870-334
Y102		CRYSTAL: 3.563795 MHz, tolerance ±.01% at 0-85°C, parallel resonant 32 pf load max. resonant resistance of 90 ohms	3870-335

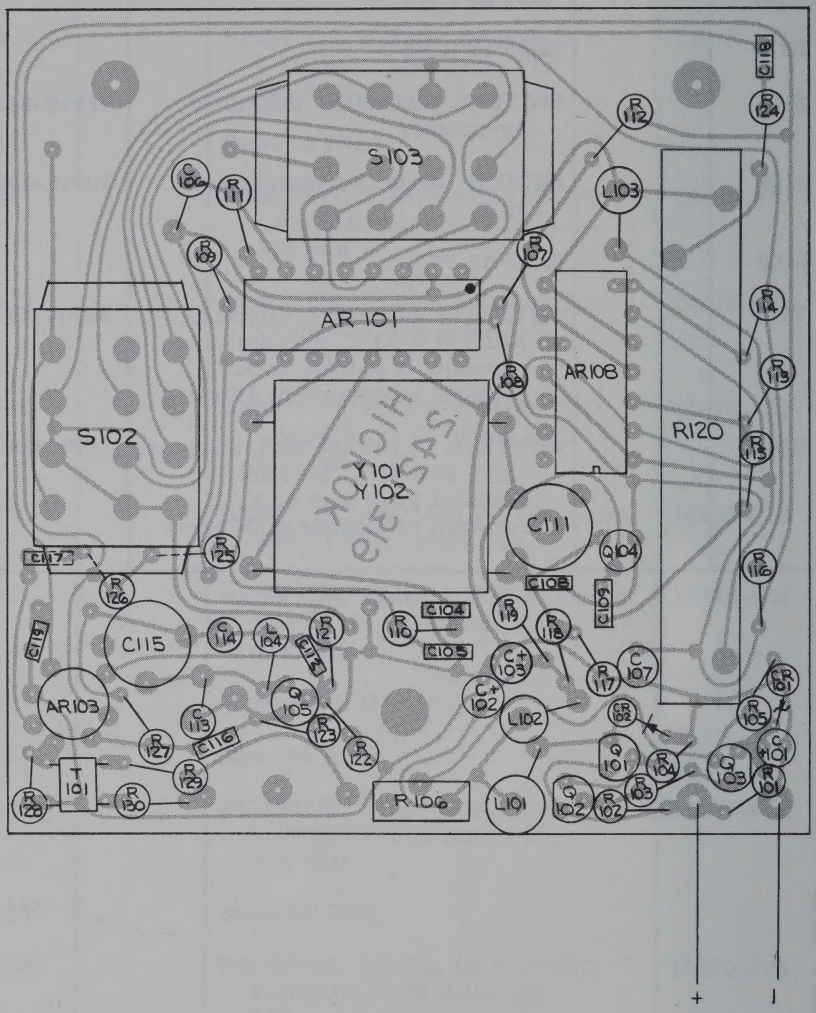
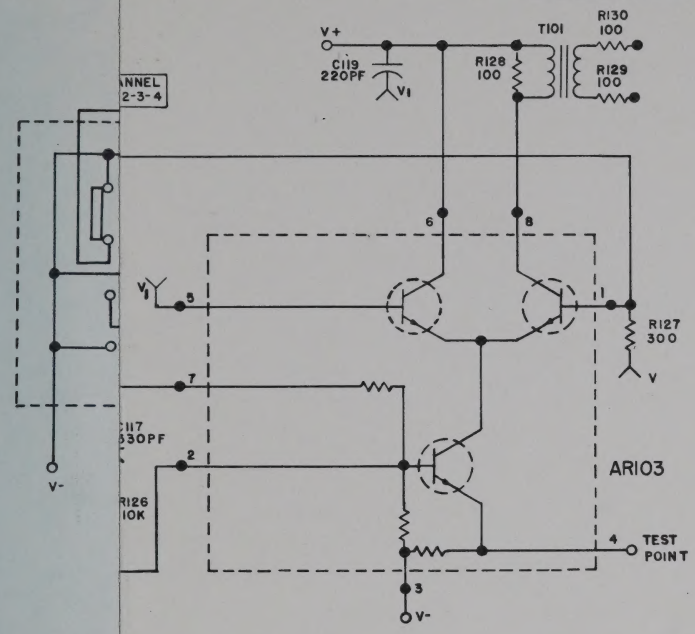


Figure 6. Parts Location Diagram Model 239 Color Bar Generator.



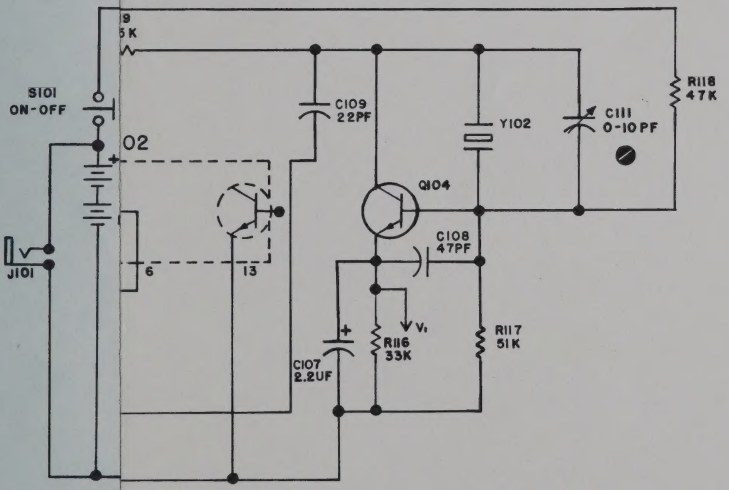


FIG. 7 – SCHEMATIC WIRING DIAGRAM, MODEL 239

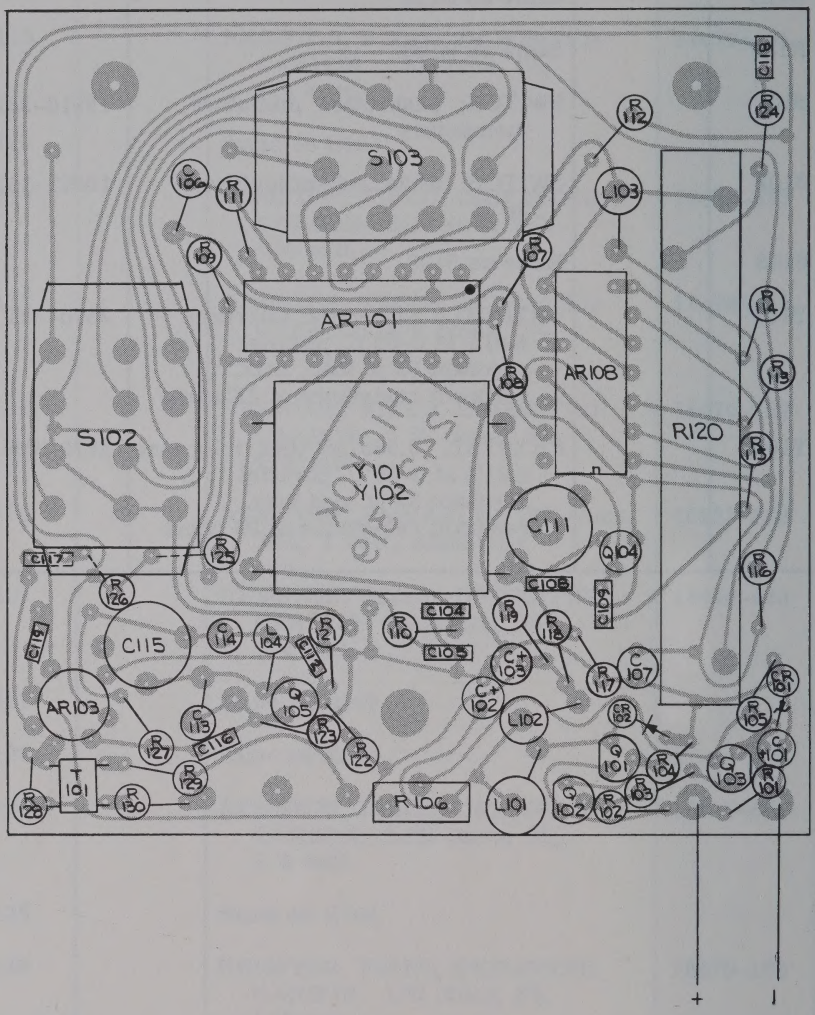


Figure 6. Parts Location Diagram Model 239 Color Bar Generator.

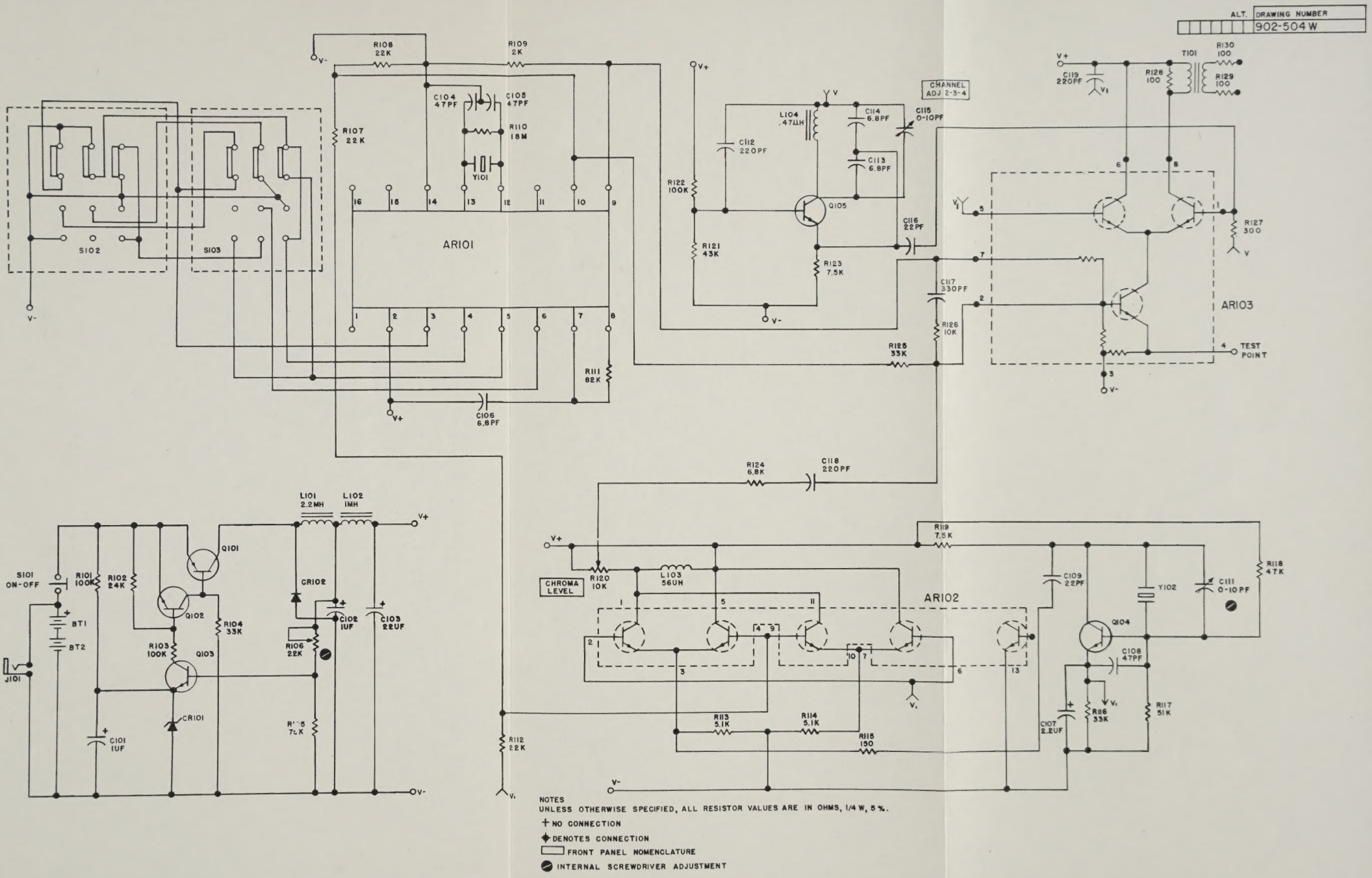


FIG. 7 – SCHEMATIC WIRING DIAGRAM, MODEL 239